Crafting, Connecting, and Commoning in Everyday Maker Projects

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Crafting, connecting, and commoning in everyday maker projects

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ABSTRACT

Makerspaces have spread to schools, museums, and libraries around the world. These are spaces that make technology construction more accessible and afford practices that situate makers as everyday designers. In this paper, the connection between makerspaces and makers’ everyday lives is examined. For this study, thirteen makers were interviewed about the process of their everyday maker projects, and the data material was analyzed for practices, reflections on agency, and relations to places like the makerspace, the home, and beyond. Three distinct practices have been discovered and are described. Crafting is an individual, recreational, skillful, and immersive practice that connects to an individual workspace aside from the makerspace. Connecting is a creative, object-oriented, and interventionist practice that connects to everyday life situations open for inventions. Commoning is a social and communal practice that connects to the makerspace community. The makers’ practices inform a discussion of the agency the makerspace enables, and the spatial practices that both enable and constrain actions. Also, because makerspaces are places that intend to make technology construction accessible and inclusive, diversity in maker communities, barriers to inclusion, and strategies to overcome these are discussed.

1. Introduction

Technology is undeniably entangled in our everyday lives. It is present when we pay with our phones in the supermarket, use our voice to control our home speakers, coordinate with partners virtually, track our movements, and so forth. On the other hand, many individuals’ daily routines become deeply dependent on technologies that only experts can comprehend and control. On the other hand, people resourcefully select, combine, place, appropriate, and repurpose technologies in creative, unexpected, and emergent ways to serve their daily activities (Wakkary and Maestri, 2006). Making is an activity where non-experts can take on the role of making, accustoming, or repurposing technology and objects (Gershenfeld, 2012; Kuznetsov and Paulos, 2010; Roedl et al., 2015). It is a practical, recreational, and social activity where the so-called “makers” use a combination of physical and digital technologies to learn about technology, express themselves, and make objects that can solve everyday problems (Gauntlett, 2018). In the process making, makers develop material skills to develop objects, social and communicative skills to talk about technology, and cognitive skills for critical reflection on technology in everyday life (Berland, 2016; Iversen et al., 2018). These potentials also motivate societal institutions like schools, museums, community centers, and libraries to dedicate space for people to access tools and materials, learn about technology, and form communities. This paper focuses on user practices in publicly-available makerspaces in Danish libraries. Library makerspaces are spaces that, in particular, aim to provide equitable access to tools and materials for making, encourage learning for their citizens, attract and foster communities, and renegotiate the relation between the library and the user (Slatter and Howard, 2013).

The popularity of making can be attributed to ‘the maker movement’ (Dougherty, 2012) that is a combination of physical makerspaces, a new generation of powerful open-source software and hardware (Anderson, 2012; Kafai et al., 2014; Melis and Buechley, 2012), traditional media and public events promoting the movement (Hepp, 2018), and an extensive online infrastructure supporting information sharing between makers around the world (Kuznetsov and Paulos, 2010; Tseng and Resnick, 2014). Scholars have pointed out that the maker movement holds liberating potential for people’s everyday lives, such as supporting creativity in everyday life (Gauntlett, 2018), including priority excluded people in technology construction and entrepreneurship (Anderson, 2012; Hui and Gerber, 2017), and strengthening critical reflection on technology construction and consumption (Iversen et al., 2018; Roedl et al., 2015). Other studies add critical remarks to the empowerment agenda, pointing out that maker communities primarily attract users who already possess technical interest, knowledge, and skill (Oreussen and Schepers, 2018; Eckhardt et al., 2021; Nagbot, 2016; Smit and

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Fuchsbberger, 2020) and that the maker movement is a top-down dissemination of political and commercial agendas connected to ethnocentric views on empowerment and the future economy (Ames et al., 2014; Hepp, 2018; Lindtner et al., 2016). Still, other scholars emphasize the mundane and recreational qualities that are connected to a productive and pleasurable leisure activity that rather serves well-being than critical engagement in changing the world (Davies, 2018; Taylor et al., 2016).

This study does not intend to decide whether makerspaces are empowering or not. Rather, the aim is to nuance the discussion by empirically exploring how people connect to social and societal institutions through practices of making in their everyday lives. Thirteen makers in five Danish publicly-available library makerspaces were interviewed about how they practice their maker projects in their everyday lives, and affiliate to contexts like home, work, and the library. The research question for this paper is how are maker projects practiced in everyday life, and how might everyday practices of making contribute to qualifying the role of makerspaces in the library and beyond? To unfold this question, three types of maker practices are analyzed and discussed in relation to the agency of individuals (Giddens, 1984; Orlikowski, 1992) and spatial practices (Harrison and Dourish, 1996; Lefebvre, 1991; Tuan, 1975). This study adds to an existing body of research on making and everyday practices by illuminating ways that makers’ diverse practices attribute meaning for individuals and transcend multiple contexts beyond the makerspace.

2. Related work

In HCI, making has caught much attention because it reshuffles the roles of users and designers. For the last ten years, a substantial body of HCI research on the topic has been developed. Scholars have examined local and global discourses and ideals of making (Lindtner et al., 2016; Roedl et al., 2015), developed and evaluated physical tools and digital platforms supporting makers (Gershenfeld, 2012; Kafai et al., 2014; Mellis and Buechley, 2012; Resnick et al., 2009; Tseng and Resnick, 2014), analyzed processes of designing, facilitating, managing, and appropriating spaces for making (Dreessen and Schepers, 2018; Menendez-Blanco and Bjorn, 2019; Seravalli, 2018), and discussed maker activities in relation to learning, community-building, and equity (Bjorn and Menendez-Blanco, 2019; Devendorf and Ryokai, 2015; Disalvo, 2014; Iversen et al., 2018; Taylor et al., 2016). While it is important to assess tools, activities, and outcomes as they take place in the makerspace, this study adds to maker research by examining the intersection between making and everyday life. Studies on making have addressed everyday perspectives, including subtle and mundane everyday care actions that are crucial for maintaining makerspace communities (Toombs et al., 2015), the experienced wellbeing of making craftwork relating to personal challenges (Taylor et al., 2016), and the inspiration makers find in their everyday lives (Gauntlett, 2018).

Also, an important aspiration of makerspaces is to enhance technical literacy so citizens can engage in dialogues about technology and make reflected decisions about technology use in everyday life (Iversen et al., 2018).

This study examines informal project-driven activities in publicly-available library makerspaces (Einarsson and Hertzum, 2020). Compared to school programs or short-term workshops, informal project-driven activities are particularly relevant from the everyday life perspective because for these users, making is a self-organized recreational activity taking place outside of school or work. The activity can take place over a longer period and interconnect with multiple places (e.g. home, work, other hobby interests, the makerspace, and the library), compete with other obligations, and attribute meaning to individuals’ everyday life. Furthering the everyday perspective enables a comprehensive picture of maker practices and makerspaces.

The everyday life perspective is operationalized in terms of a practice-oriented view tied to the so-called third wave of HCI research. This line of research focuses on technology in relation to human motives and social contexts, and it is a response to a generation of technologies that broaden, internmix, and embed in people’s lives at work, at home, and beyond (Badker, 2006; Harrison et al., 2007; Kuutti and Bannon, 2014). In other words, technology is designed to support particular tasks, but also implies a human engagement with objects by accustoming, combining, placing, appropriating, and redesigning them in creative ways to suit the diverse patterns of individuals’ everyday lives. In particular, an everyday perspective opens up for understanding making as a material engagement that 1) transcends multiple contexts in makers’ lives, 2) serves social, practical, and recreational objectives, 3) connects to more or less articulated rules and routines of societal institutions, and 4) (re)produces the institutions through actions.

2.1. Agency and space

There are multiple views on agency and power in HCI research. Schneider et al. (Schneider et al., 2018) demonstrate this exemplarily by surveying 54 CHI articles for notions of empowerment such as the power-to act or power-over to enforce actions, the manifestation as a feeling, action or knowledge, and temporary or long-term persistence of empowerment. Power-over is a realist idea in which power is coercive and distributed among actors in an isolated system. Power-to is the individuals’ capacity to act on behalf of a future good. The power-to act does not necessarily require other actors to give up power (Schneider et al., 2018). While coercive power struggles undeniably also take place in the makerspace, this paper relies on structuration theory (Giddens, 1984) that considers power - the individuals’ capacity to act – as embedded in social institutions constituted by everyday life practices.

From a structuration perspective, human actions and social structures form a recursive relation that is mutually constitutive. Institutions like the home, workplace, makerspace, or the local library all provide rules and resources that condition possible human activity. The structures are both enabling and constraining for human actions, and individuals’ produce and reproduce them through their actions. Wanda Orlikowski (1992) introduced Giddens’ (1984) work to information systems research almost three decades ago, clarifying the role of technology. In her model, technology is framed as a product and medium of human actions. Technologies are designed by people and influenced by organizational practices, norms, and culture. Yet, through use, people can conform to the institutional conditions or they can resist by appropriating, and thereby, potentially affect the organization. Translated into making, makers are enabled by the tools and resources made available in a makerspace, but there are limitations inherent to the tools available. There are also more or less formalized rules in a makerspace that affect possible behavior.

While Orlikowski proclaimed the duality of technology as a framework to understand technology neither as deterministic nor as completely enabling, her later work directs attention to sociomaterial practices. Guided by STS and actor-network theory, sociomateriality represents an approach to understand the performative role of technology that is entangled and constitutive for human practices that has attracted much attention in the HCI community (Frauenberger, 2019). This view is not much different to viewing technology as mediating (Kaptelinin and Nardi, 2006) or as a resource (Giddens, 1984) but it directs attention to the emergent and entangled practices that are constituted by and constitutive for technology.

While emergent practices in everyday life must be recognized (Wakkary and Maestri, 2008), structuration also adds value by addressing systemic and historically developed ideals, practices, and challenges that are more or less consciously reproduced in practice. That can help to address making as a practice that reproduces order in everyday life, the unconscious reproduction of inequalities in making, and the implicit rules that affect possibilities for makers when a makerspace is connected to established cultural institutions such as schools (Halverson and Sheridan, 2014), museums (Braybrooke, 2018),...
community centers (Taylor et al., 2016), or libraries (Willett, 2016) as in this case.

French Marxist philosopher, Henri Lefebvre, argued that space is not an empty container but constituted by a triad of forces. According to Lefebvre (1991), spaces are made of 1) the representations of powerful actors (experts) planning the spatial organization and anticipating the use, 2) the habitual use in everyday practice that aligns the space to routines, and 3) the representations of symbols that signal ways the space is lived.

In a similar way, Harrison and Dourish (1996) introduced the notion of space and place to the HCI community stating that ‘Space is the opportunity; Place is the understood reality’. Space includes the material aspects such as people, objects, and their proximity that provide opportunities for actions. Place, however, is a layer on top of spaces that provides social rules and structures, suggesting what is appropriate or not. Although, the social structure can be considered limiting, it provides continuity, stability, and security that makes a place (Tuan, 1975).

Researchers examining makerspaces tend to be aware of the distinction between the space as designed versus the space as used and appropriated. Lindtner and her colleagues (Lindtner et al., 2015, 2016), for instance, disclose the social, cultural, and economic conditions affecting the view of hacking across the world:

“It is particularly ironic, then, that while open hardware hacking in the West is celebrated as an enabler of future innovation, the open manufacturing mechanism of shanzhai is often denounced of holding China back on its path to modernization” (Lindtner et al., 2015)

This example illustrates that open hardware itself is not empowering or democratic. Instead, to make makerspaces work in social, material, and cultural conditions, the ideals are appropriated into the local contexts. Menendez-Blanco and Bjorn (2019) study the appropriation through Facebook activities of 15 makerspaces in Copenhagen. They find that subtle visual and discursive cues communicate to users what is unique for every space and delimit the insiders from the outsiders. It determines which groups are most welcome, what is appropriate to construct, and the skill level required for participating. Such communications are on the one hand exclusive, but it also constitutes and reinforces the makerspace, its uniqueness, and its community. In addition to the subtle cues, library makerspaces also hold institutional expectations that affect who enters and what may be produced. Librarians implement makerspaces to attract new users, allow access to tools for expression, enhance digital literacies, and support community-building (Slatter and Howard, 2013; Willett, 2016). Also, library makerspaces symbolize a reorientation away from the library as a knowledge repository towards a performative use of the library where the user takes an active role in producing and sharing information instead of merely accessing and consuming it. Library makerspaces can be configured in multiple ways (Caso and Kuijper, 2019) and support a wide range of activities (Einarsson and Hertzum, 2020) but they in particular hold a democratic commitment to be accessible for and reflect the diversity of citizens in their communities (Audunson, 2005; Jochumsen et al., 2017).

3. Methodology

3.1. Everyday life

Practices such as making are material engagements that require competence and create meaning for individuals (Shove et al., 2012). In everyday life, practices flow across a mosaic of contexts and places (Bakardjieva, 2011) and are organized, timed, scaled, and accustomed to suit the rules and obligations at home, at work, at the makerspace, or in other leisure engagements. This study draws on interviews with thirteen makers that engage in library makerspaces about their maker projects. While observations in everyday life can provide an in-depth account of emergent practices and creative appropriations in use (Wakkary and Maestri, 2008), the benefits of interviews are that they can scaffold reflections about the interconnected places and activities beyond the immediate situation.

3.2. Recruitment

The data material for this research is based on semi-structured interviews with thirteen makers recruited from makerspaces in five Danish public libraries spread across three regions in Denmark. The participants were identified and selected from a user survey distributed in the five makerspaces on their local Facebook groups. The survey included questions about the users age, gender, level of experience, frequency of use and length of affiliation, motivations, satisfaction with tools, space and services, and perceived barriers of use regarding their local library makerspace. In total, 79 makerspace users completed the survey and 49 agreed to be contacted for a follow-up interview. Only makers that had completed makerspace projects were recruited. Also, to encompass the diversity of user’s practices, maximum variation within the sample was sought. This included striving for fair representation of the five makerspaces, and diversity in terms of demographic characteristics, experience levels, use patterns, and motivations for participating in the makerspace. 17 users were invited for a follow-up interview and 13 makers agreed to participate. The participants’ backgrounds and projects are described in Table 2.

3.3. Interview procedure

The interviews were semi-structured and conducted virtually through Zoom (N=8), Microsoft Teams (N=1), or by phone (N=4). The interviews lasted one hour on average and were separated into two parts. The first part of the interview prompted the participants’ trajectory of becoming members in the makerspace and follow-up questions regarding use patterns, motivations, and barriers based on their survey responses. This part provided general discussions about the affiliation to the makerspace and motivation to participate.

As agency in this research is considered to be embedded in everyday practices, the second part of the interview focused on providing detailed descriptions of the participants’ projects, including their sequences of steps in projects, flow across places, problems encountered, experiences in particular situations, and actions to overcome problems. A shared spreadsheet was used to map the projects during the interview because both maker projects and everyday life practices can be difficult to articulate due to their practical, non-controversial, and tacit nature. During the interview, the participants were first asked to outline the steps of their project (mapped in the columns). Then, within each step, participants were prompted to answer the following questions:

- Please explain what happened during this step. (Headline)
- Where did this step take place, and were other people involved? (Context)
- What emotions did you experience during this step? (Emotions)
- What challenges or setbacks did you experience in this step? (Barriers)
- What information did you seek during this step? (Information interaction)

Visualizing the steps for the participants supported reflection on their process. This included connecting places, information-seeking patterns, and emotions as part of specific tasks, the articulation of detailed and tacit considerations and decision-points in user projects, and reasons behind their actions. Also, the overview supported participants recalling taken-for-granted actions in between the steps or in earlier stages of the projects. Due to the reflections made during the interviews, interview questions were not asked in sequential order but rather addressed as topics to cover within each step. The interviews were finalized when a comprehensive overview had been established.
3.4. Data analysis

The virtual interviews were video recorded, and phone interviews were audio recorded with consent from participants. All interviews were transcribed. Nine of the participants also provided additional documentation in the form of photos and models of their projects. The data material was analyzed in three iterations, comprising coding, summarizing, grouping, and theorizing. First, all interview manuscripts were coded for statements revealing background information, practices, reflection on agency, and affiliation to space and place (see Table 1).

Coding was conducted by the author to detect relevant characteristics for grouping. The topic of interest is the makers’ everyday life, and therefore, the unit of analysis is a holistic view of the individual makers’ practices, meaning-making, and spatial affiliations. Therefore, the codes were analyzed and summarized in a document characterizing each makers’ practices, affiliation to space, and reflection on the agency. A comparison of the thirteen interview summaries revealed variations in terms of the following:

- Competence reflected in the complexity of the project
- Motivations, goals, and objectives of the maker project
- Use of and affiliation to the library, the makerspace, and the community
- Interconnections between the maker project and other places, like home, work, or other hobby interests

In the comparison, three types of practices were identified:

1. Crafting, an individualistic, skillful, immersive, and intrinsically satisfying material engagement. The practice is sustained over time and acknowledges a historical discipline. This practice is primarily placed in a personal workshop where the makerspace holds a secondary role that is supportive or practical.

2. Connecting, a creative, object-oriented, individual, and expressive practice. This practice is temporary and combines the ability to

detect meaningful situations in everyday life that are open to intervention and the use of possibilities in the makerspace to make the intervention.

3. Commoning, a social and communal practice. The practice is sustained participation in the makerspace motivated by and contributing to the makerspace as a place.

The categories are not mutually exclusive and reflect a spectrum of spatial practices that can be combined. Nonetheless, all users were affiliated and analyzed as part of the primary practice driving the makers activity. The participants’ background and motivations, and projects are described in Table 2. John, Simon, and Svend’s practices are grouped as commoning for their close affiliation to the makerspace community. Emma, Jacob, and Lars’ practices are grouped as crafting through their attention to detail, expertise within a domain, extensive processes that include several iterations, and individual pleasure in tinkering. Finally, Peter, Lana, Fiona, Carla, Kim, Mark, and Niels’ practices are grouped as connecting due to their care for symbolic representations in their designs and their ability to use tools in the makerspace to make objects for other situations in their lives.

4. Results

In the following, the practices of crafting, connecting, and commoning are unfolded. Crafting (Sennett, 2008), connecting (Gauntlett, 2018), and commoning (Hillgren et al., 2016) are not unfamiliar terms in the maker literature, so the findings are complemented by prior research. The results section focusses on uncovering the three practices, including their material engagement, competences, barriers, and relation to everyday life that informs a broader discussion of place and agency in making in the discussion section.

4.1. Crafting

In “The Craftsman”, Sennett (2008) describes how craft is about the intrinsic satisfaction of doing good work, caring about detail, and making quality products. Craftpeople connect to a discipline and repeat their actions over and over again to specialize and refine their skills. Three of the thirteen interviewed makers’ primary practice qualifies as crafting for their described pleasure in being immersed in their projects, having deep and skillful engagements with materials and tools, and striving to improve the quality of their projects.

Crafters take on complex projects, and they work individually. For instance, Lars (Fig. 1), who is a maker and a train hobbyist. From visiting conferences and participating in train modeling communities, he noticed that all tracks are decorated with houses, and identifies that there could be a market for prefabricated houses based on the Danish architectural discipline ‘Bedre Byggeskik’ (Nielsen, 1980). Lars is already skilled in 2D and 3D drawing, so he starts spending time in his home office researching Danish standard architecture, reading books about the topic, and drawing and refining 2D and 3D models until they look realistic. Because he enjoys the process and other train hobbyists might use his models, he cares about the quality of materials, smart and easy-to-use design, and details. Therefore, his prototype has gone through multiple iterations, and he spends several evenings nurturing for the details such as making integrated lights with invisible wiring.

The three crafters are self-sufficient in most aspects of their projects and prefer to carry out most tasks in their projects individually in their home office or their private workshops. The crafters’ projects follow a similar iterative pattern of researching, analyzing, designing, and modeling at home. The makerspace then serves primarily as a place to access tools the crafters do not have at home, and to receive feedback on concrete prototypes or seek qualified advice regarding problems they meet. All three crafters attend the makerspace but they are not necessarily closely connected to it. Lars values aspects of sharing knowledge and learning from others, while Emma and Jacob rather highlight the

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### Table 1. Coding scheme.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>Statements that describe the participants’ personal and professional background, the trajectory to become a maker and makerspace participant, descriptions of personal philosophies, motivations, and level of expertise.</td>
<td>'I’m a trained electrical engineer in defense, and I have always been interested in technology. I heard that one of my former colleagues attended the makerspace. He approached me and persuaded me that the makerspace was a place for me.'</td>
</tr>
<tr>
<td>Described practices</td>
<td>Statements that describe projects or actions during maker projects, including steps and procedures, challenges, decision points, the context of action, and temporality in projects.</td>
<td>'I change a lot during the design process. Then, I think about the solutions, and after a few days, I think ‘that could be solved in a smarter way by this or that.’ The brain is at work and constantly developing.’</td>
</tr>
<tr>
<td>Reflections on agency</td>
<td>Statements that describe the participant’s perception of the agency, including ways maker tools, maker projects, or makerspace enable or disable actions. Also, actions reproducing the social order were coded.</td>
<td>'I think I started to make something useful. I don’t make down payments because that wouldn’t make sense. If I can buy things cheaper at the store, I don’t make them myself.’</td>
</tr>
<tr>
<td>Relation to space and place</td>
<td>Statements that describe the participant’s perception of places, including affiliations to the makerspace, library, other hobby communities, and home.</td>
<td>'As you might sense, I have a lot on my plate and need to prioritize between my family, makerspace or motorcycle, and here, I must prioritize the makerspace because it is ‘bygge’.’</td>
</tr>
</tbody>
</table>
Table 2. Participants, their age, years of makerspace experience, background and motivations, and projects described.

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Years of experience</th>
<th>Background and motivations</th>
<th>Project deconstructed during interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>John</td>
<td>50+</td>
<td>2</td>
<td>John is a software engineer and a driving force in the makerspace. Aside from participating in collaborative projects, he tutors users in the makerspace. John participates in a collaborative makerspace project of building a water UAV. During the project, participants both work collaboratively on scoping, selecting templates, testing solutions, and discussing alternatives. Work is also distributed between individuals. Most aspects of the project take place in the makerspace but participants also coordinate externally at a conference. The project requires using multiple skills in electronics and construction. The project is carried out both in the makerspace and in his home office and presented externally at a conference representing the makerspace.</td>
<td>makerspace to acquire help in areas where he is less proficient such as programming microcontrollers. Lars is a professional ship controller and train model hobbyist who uses the makerspace when he is off duty. He is a regular participant in the makerspace, and an expert user in laser cutting.</td>
</tr>
<tr>
<td>Simon</td>
<td>50+</td>
<td>1-2</td>
<td>Simon is an electrical engineer and a regular participant in the makerspace. For years, he has tinkered with electronics at home, and for him, the makerspace is an opportunity to share his hobby with like-minded people. Simon makes an Arduino-controlled device for distance measurement to be presented by the makerspace at a conference. The project requires using multiple skills in electronics and construction. The project is carried out both in the makerspace and in his home office and presented externally at a conference representing the makerspace.</td>
<td>Peter is a marketing professional who retired early due to a stroke. Peter uses the makerspace to make prototypes and discuss his ideas with others.</td>
</tr>
<tr>
<td>Svend</td>
<td>50+</td>
<td>1-2</td>
<td>Svend works for the local municipality, and is a regular participant in the makerspace. He uses the makerspace to tinker with 3D- and electronics projects, to learn, share with others, and be a part of the community. Svend makes an exhaust system for the basement at home. He iterates between tinkering with the controller at home and seeking assistance and borrowing components from users in the makerspace.</td>
<td>Lana is an unemployed landscape architect and a mother of two daughters. She uses the makerspace occasionally to make t-shirt prints and other creative projects. Her family is also involved either with her in the library makerspace or in the creative process. Fiona is a recently retired library professional who got involved in the makerspace through her work. She attends the makerspace alone during the day to rehearse her skill to make objects like t-shirt prints and laser cut suitcase tags.</td>
</tr>
<tr>
<td>Emma</td>
<td>50+</td>
<td>1-2</td>
<td>Emma is a retired designer. The makerspace enables her to maintain and develop her design abilities. She mostly uses the makerspace to produce prototypes. She enjoys the useful feedback from selected users in the makerspace but is interested in the community due to their focus on technology instead of making useful things. Emma makes a 3D printed prototype of a folding table for the home. She approaches the design process in a structured way that allows her to reflect on detail and receive feedback from others. Her final 3D design is to be manufactured by a local craftsperson.</td>
<td>Carla is a retired teacher who has spent much of her life on creative unfoldings like woodworking, drawing, and carpentry. She uses making as a mental exercise but also appreciates help from users of all ages in the makerspace.</td>
</tr>
<tr>
<td>Jacob</td>
<td>50+</td>
<td>2</td>
<td>Jacob is a software engineer who spends much of his spare time in his personal woodworking workshop in his basement. He uses the makerspace to acquire help in areas where he is less proficient such as programming microcontrollers. Lars is a professional ship controller and train model hobbyist who uses the makerspace when he is off duty. He is a regular participant in the makerspace, and an expert user in laser cutting.</td>
<td>Kim is a professional ship controller and train model hobbyist who uses the makerspace when he is off duty. He is a regular participant in the makerspace, and an expert user in laser cutting. Lars makes laser cut reconstructions of buildings intended for hobby train environments. He makes three types of houses over several iterations, striving for sufficient quality and detail to get his product acknowledged by other train hobbyists and potentially sold. Lars makes a redesigned prototype of a wheelchair due to his personal situation. During the project, friends, makerspace staff, and external actors are involved in providing feedback. He uses the makerspace to seek assistance in 3D-design and production but develops the models at home.</td>
</tr>
<tr>
<td>Fiona</td>
<td>50+</td>
<td>2</td>
<td>Fiona is an unemployed landscape architect and a mother of two daughters. She uses the makerspace occasionally to make t-shirt prints and other creative projects. Her family is also involved either with her in the library makerspace or in the creative process. Fiona is a recently retired library professional who got involved in the makerspace through her work. She attends the makerspace alone during the day to rehearse her skill to make objects like t-shirt prints and laser cut suitcase tags. Carla is a retired teacher who has spent much of her life on creative unfoldings like woodworking, drawing, and carpentry. She uses making as a mental exercise but also appreciates help from users of all ages in the makerspace. Carla makes laser cut pieces for a board game for son. She enjoys being able to help him and upcycle the game. She makes the pieces during a couple of weeks, selecting appropriate designs, choosing the right tool for the task, and finally, laser cutting the pieces. Except for handing over the present, all parts of her project take place in the makerspace.</td>
<td></td>
</tr>
</tbody>
</table>

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Table 2. (continued)

<table>
<thead>
<tr>
<th>Name</th>
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<th>Background and motivations</th>
<th>Project deconstructed during interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim</td>
<td></td>
<td>&gt;2</td>
<td></td>
<td>Kim makes a boat sign with his friend for a third party. His friend told him about the goal to make the sign and Kim suggested making it in the makerspace, and helping him with the process. Kim helps to design and produce the sign but is not involved in handing over the present.</td>
</tr>
<tr>
<td>Mark</td>
<td>20-29</td>
<td>&gt;2</td>
<td></td>
<td>Mark got involved in the makerspace after taking an introductory tour of it with his friends. After that, he has tinkered with the tools in the makerspace and took interest in 3D-design and printing because it intersected with his hobby of role playing.</td>
</tr>
<tr>
<td>Niels</td>
<td>&gt;50</td>
<td>&lt;1</td>
<td></td>
<td>Niels is an IT security consultant and uses the local makerspace occasionally. He is attracted to the makerspace because he enjoys tinkering with technology but feels too shy to participate fully in the community.</td>
</tr>
</tbody>
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benefits of getting specific help or feedback on their constructions. Emma dislikes the community’s focus on technology instead of the design of usable products, and Jacob argues that the connection between the library and makerspace is inappropriate and a waste of public resources. Nonetheless, through the makerspace, the library has successfully attracted users who otherwise would not have come there: “Before, I’d never set foot in the library. I searched the internet for books. Now, I use it a lot to get information and bring books home instead of buying them” (Emma). As Emma articulates, her participation in the makerspace not only brings her to the library but also converts her into using traditional library services.

Crafters acknowledge and rely on a history of knowledge and expertise. Instead of viewing the future as open for change, crafting is about a complex dialogical relation between past, present, and future (Crook, 2009). The crafters have a connection to the past by acknowledging design, woodworking or house construction as historical practices. Emma, for instance, applies her systematic approach to design from her career in the textile industry in her projects, Jacob follows selected craftsmen on YouTube, and learns standard techniques and processes, and Lars examines books about architecture for details about materials of the houses and the processes of their constructions. More directly, crafting contains a series of iterations where quality is improved, practices are repeated, and skills and know-how are acquired. For instance, Jacob has engraved hundreds of cutting boards in different materials, patterns, and at different levels of difficulty with his CNC mill. This, according to Sennett (2008), is the repetition that builds craftsman skills, specialization and enables the crafters to take on complex projects.

As Sennett argues, craftsmanship is about the quality work for the sake of it. Therefore, for the crafters, making quality items is more important than finishing quickly or taking the fastest route. Emma, for instance, explains, “You need to know what you’re doing. That’s why I’d never download files from the internet. I need to know how they’re made. There is no easy solution; I need to figure it out myself”. Although it might be a slower path to the solution, crafting appraises the value of control and autonomy of the design. Jacob also adds that autonomy contrasts his crafting from his day-to-day job:

The fascinating thing about going down to the basement and making something is that you aren’t accountable for your time anymore. At work, you’re measured by the time you spend in accomplishing something. When I go down to the basement, I can have an idea, spend days on it, and if it doesn’t work, no one cares.

Jacob’s statement both reflects the therapeutical aspects of crafting and the joy in the process. Yet, it also reflects a difference between hobbyist crafting and modern professional labor. Jacob’s work as a software engineer is rewarding for him because he delivers results and satisfies customers’ needs. Yet, time often constrains him in producing the most appropriate solutions or tinkering with the details he cares about. As Sennett also argues, technology has deprived workers of repetitive and holistic practices. In contrast, crafting allows a holistic process where there is a direct connection between efforts, iterations of testing, and the quality produced that is satisfactory for crafters. For people like Jacob, making hobby projects is not about the product but the satisfaction of connecting to a holistic process that is a recreation from work.

4.2. Connecting

Makerspaces allow people otherwise excluded from technology construction to take part and express themselves in new ways. Gershenfeld (2012) claims that people, with a new generation of fabrication tools, can “make almost anything” that captures the liberated spirit of connectors. In the same optimistic vein, Gauntlett (2013) argues in
favour of the creative potential of the current generation of digital technologies. Making, according to Gauntlett (2013), is about connecting materials and ideas, social relations, and virtual and physical communities for self-expression.

Seven of the thirteen makers’ primary practice is connecting. As a maker practice, connecting is about detecting problems or opportunities for interventions in the everyday, and despite limited experience, apply tools in the makerspace for projects to make the intervention. These projects are short-term, at times limited by a deadline, require little prior technical experience, are manageable in their complexity, and connect to other personal hobbies or social bonds outside the makerspace. Thus, projects can have diverse outcomes, six of the seven connectors interviewed engage in making personalized gifts for friends and family. Lana (Fig. 2), for example, engages in making a textile print on a tote bag for a teacher in her child’s kindergarten. The teacher is likely for making sketches that the children then color. Therefore, Lana decided to print one of the sketches on the tote bag that symbolize their appreciation. To do so, she uses a prior sketch as a reference and marks up the lines at home. In the makerspace, she makes a vinyl cut and presses it into a tote bag. While this process does not require advanced skills, the importance for the connector is deciding the appropriate motive with a symbolic expression reflecting the relationship between the giver and receiver.

Because the connectors are more drawn by the symbolic communication established in the early stages of the projects than details in the production, the objects represent a lo-fi aesthetics (Spencer, 2008). Mark, for instance, clearly states that connecting is about the goal, not the process: “Again for me, the process is insignificant. It’s a means to an end. It’s not something I find super intriguing but rather a part of the production of the project”. To make a club for his roleplaying friend, Mark searches online databases for premade 3D objects on Thingiverse, remixes them into his personal production, and when finished he shares images and 3D-models in a role-playing Facebook community for others to use. Like the other connectors, he is focused on the goal, and therefore, he spends little time experimenting or adding complexity. Similarly, Fiona explains that she only fixes major problems, not minor mistakes in her project. She elaborates that when making t-shirt print for her two granddaughters; she encountered two problems: First, there was a misspelling in the print that she chose to correct. The second problem concerned inserting text and images on the same t-shirt. She knew when printing both at the same time would enhance alignment and quality. However, after tinkering with it for a while, she selected the easier alternative of printing in two rounds. “Well, the result was good enough for the children, but I felt that I cheated. Sometimes you cheat and pick the easiest solution. I just became tired of tinkering with it. I sometimes do that when things become too cumbersome”. Connectors do appreciate mastering the tools and processes, but they also work around problems with the tools at hand to get things done quickly. That reflects that creative and expressive qualities of connecting can constrain deep understanding of specific tools, materials, and processes.

Connecting is also a practice that associates with a multiplicity of places. First, connectors are connected to the context of use. This is reflected in their symbolic communications expressing an understanding of the preferences of the receiver of a gift or subtle codes in a hobby community, involving family or friends in the process or making objects addressing problems in their own everyday life. Second, connectors connect to multiple platforms online. They seek information intensively when defining a project or problem-solving and follow hobby groups on social media platforms. Here, they are also presented with solutions that might apply in their everyday context. Third, they are connected loosely to the makerspace. Most of the connectors only participate in the community when they have a relevant project and prepare most designs at home. While connectors might not have skill or interest in taking on complex projects, their agency lies in the ability to notice appropriate situations in their everyday lives to apply technical possibilities in the makerspace.

4.3. Commoning

Commoning is a set of practices of sharing resources, information, and ownership of the makerspace (Hillgren et al., 2016; Seravalli, 2018). This is in line with characterizations of makerspace by their physical, co-located qualities that afford collaboration, peer assistance, and the development of friendships. Accordingly, Taylor, Hurley, and Connolly (Taylor et al., 2016) emphasize the social values in communal makerspaces: “Makerspaces are rarely just where fabrication could be carried out. Rather, they are hubs of community, where people come together to work together, learn from each other, or simply socialize”.

Three of the makers’ primary practices in the makerspace can be characterized as commoning. For users practicing commoning, the social qualities and collective goals in the makerspace are equally important for their maker projects. The users develop strong bonds with the makerspace because they attend it regularly, whereby it supports them in getting to know other users and continuously strengthen their relations with them. Simon explains the social atmosphere with the Danish phrase ‘hygge’: “to be able to go there and talk to others and ‘hygge’. You can just be in the makerspace and ‘hygge’ where you don’t have a project per se”. For Simon, ‘hygge’ represents an informal space where there are no requirements for participation or formalized deadlines or goals to adhere to. Instead, there is space to tinkering with technology, discuss with other users, and feel accepted and a sense of belonging. The co-situatedness also affords informal exchanges of information and stuff. As Svend argues, “I prefer the physical contact. Not because I don’t use the internet. I do that in my daily life, but I enjoy talking to people, and there are some very engaged helpers and users in the library”. While the commoners do use the internet to seek inspiration, acquire components or problem-solve, the co-presence and
informal support in the makerspace are driving for their sustained participation.

For users practicing commoning, the collective goals of the makerspaces at times overrule the makers’ engagements in projects. For example, for John who is a founding member and a volunteer in the makerspace. The tools in the makerspace are intuitive for him due to his work as a software engineer but still, he describes his role as primarily to support others getting started or providing assistance to projects. When he engages in projects, these are either small-scale projects or collaborative projects. He participates in a project about making an unmanned underwater vehicle (UUV) (Fig. 3). In the project, four makers collaboratively selected a reference to build upon and contribute to each with their area of expertise. One maker made 3D-printed propellers, another build the frame and gathers components, while John contributes with his programming skills. Yet, as John is committed to inspiring others to work with technology, the main purpose of the project for him is to do “something while you’re there anyway.” In a similar way for the three commoners, their projects are not driven by deadlines and have a form that can be packed away, stored, and revisited. Commoning, therefore, is not per se a project-driven and goal-directed practice. Rather, it is a practice that reciprocates to the community and acknowledges the makerspace as a socially meaningful place. The role of the project, therefore, is not in producing the object itself but also to legitimize participation in the makerspace.

As commoning reflects an ongoing participating and close connection to the makerspace, it also shapes the space. In the library makerspaces, the data material suggests that commoners meet around a shared interest in electronics and technology. All three users who primarily practice commoning attend the same makerspace, have professional backgrounds in electronics and engineers, and even use the space to connect to old colleagues: “Many of us know each other in advance. I’ve worked with several of the other users. They’re also technicians, have the same interests, and then we meet there” (Simon). Being together in the makerspace is both socially valuable but also affords the users to share information and resource, observe each other’s projects, and discuss ideas. While these users are willing to share knowledge and expertise, strong bonds in the community and a focus on technology can be a barrier for newcomers.

5. Discussion

The maker movement provides a discourse about democratizing technology production that has caught the attention of universities, schools, libraries, and museums. As other authors have stated before me, the discourses of empowerment through making are shaped by cultural conditions, supported by political and economic incentives, and at times exaggerated (Ames et al., 2014; Hepp, 2018; Lindtner et al., 2016; Roedl et al., 2015). Undeniably, the current generation of physical and digital tools (Anderson, 2012; Gauntlett, 2018; Gershenfeld, 2012) makes technology production more accessible for the general public. Nonetheless, discourses of empowerment, counterculture, and innovation are at the risk of blurring how making is practiced by users in their mundane everyday lives. The everyday life perspective recognizes that individuals traverse multiple contexts to achieve their personal goals. It also highlights the extraordinary in the everyday, the mundane routines, and the authenticity and unobtrusiveness that can provide conditions for growth (Bakardjieva, 2011). This research discloses the multiplicity of practices that constitute the makerspace and contribute to shaping institutions beyond it, such as the library.

5.1. Individual agency of makerspace users

It is evident from the data material that crafting, connecting, and commoning are practices that enable production of objects, not technology. For some users, the process of making enables them to develop, be creative, learn, relax, or build social relations. For others, it is about the outcomes, such as solving an everyday problem or personalizing an object for a particular person. While all makers need to prioritize time from other activities for their projects, crafting and commoning in particular build on long-term routine engagement. Commoning requires continuous participation in the makerspace to develop a close connection to other users, and crafting is an incremental development of competence, material know-how, and affect for quality objects over time. While research has stated that crafts may be seen in opposition to the alienating forces of capitalist production (Campbell, 2005; Sennett, 2008), the results of this study add more complexity to this argument. Crafting is a recreational practice that affords autonomy and control over processes and outcomes. Crafting may be understood in opposition to work, but crafters in this study view their practice as a complement to work building on top of professional experiences or of making as a recreational supplement to their work. In a similar way to Hallnäs’s (Hallnäs and Redström, 2002) description of everyday life objects that fade into the background and become subtle parts of our lifeworlds through their meaningful presence, the continuity of crafting also becomes part of the makers’ lifeworld. Crafters in their home workshops or offices immerse themselves in their projects, nurture for the details, iterate on designs, and continuously refine their skills for the intrinsic pleasure of the process. They apply priorly acquired experiences, comply with a discipline, and foresee future steps. Eventually, the activity fades to the background and turns into intrinsically meaningful practice. Connecting, on the contrary, builds less on continuity and more on detecting a problem and combining it with the appropriate tool. Connecting is a short-term, object-oriented practice that is enabled by access to tools through the makerspace. Connecting does not celebrate the ‘Creative genius’, but the everyday life creativity (Gauntlett, 2018; Tanggaard, 2013). As Tanggaard (2013) explains, everyday creativity is not just about the materialization of an idea (invention) but also applying it to social practices. As connectors seek the easiest path to their goal, their creativity lies not in the construction itself. Rather, their creativity is in developing an expressive object and introducing it into a new context, for instance by gift-making. While tinkering with technical problems might motivate crafters and commoners, it frustrates and discourages connectors. Commoning appraises and reproduces the social aspects of the makerspace, in which personal projects are not the

Fig. 3. John’s collaborative project – Common reference and guide, 3D-printing of propellers, and testing a motor in water.
end in themselves but rather a means to legitimize participation and socialization. While connectors and crafters may be viewed as pragmatic, networked individuals who connect loosely to multiple spatially distributed communities (Rainie and Wellman, 2012), commoners appraise face-to-face meetings, continuous participation, and a sense of social belonging.

To summarize, makerspaces are resources that enable recreation, socialization, and intervention in everyday life. Reflecting on the diversity of practices can be useful for practitioners to understand what drives makers’ participation in the makerspace, and to address potential pitfalls in the makers’ activity. For instance, connectors might need support and help to take on more advanced projects, crafters might need support and encouragement to share their competences and ideas, and commoners might need support to identify and develop relevant projects.

5.2. Making of places

The spatial practices also signal what behavior is ‘in place’ (Harrison and Dourish, 1996) in the makerspace. In particular, the community of participants who regularly participate, take interest, and develop ownership of the space reflect the boundaries of the makerspace (Menendez-Blanco and Bjørn, 2019). In alignment with prior research (Dreessen and Schepers, 2018; Eckhardt et al., 2021; Nagbot, 2016; Smit and Fuchsberger, 2020), this study finds that maker communities – also in libraries – attract male users with a background in electronics or engineering. Smit and Fuchsberger (2020) precisely articulate the paradox of a homogeneous community as the following: “[...] community can be a double-edged sword, providing support and relationships to those in it, but further alienating those who are not”. This study also finds that some crafters and connectors do avoid the community due to priorities in their everyday life activities, personal preferences for working alone, and because they are most interested in their personal projects. Few makers also mention that it is due to the gender distribution and feeling of not being represented in the community. From the perspective of Lefebvre’s (1991) triad of forces that make up a space, makerspaces are made of practitioners organizing the space and planning activities, regular users shaping the space through their practices, and the signs and symbols reflecting the place. These are also dimensioned to reflect on how makerspaces could become more inclusive. From the planning perspective, practitioners can seek to make their makerspace more inclusive by making rules and overtake responsibilities from the community. This approach can be necessary in situations where the community causes conflicts or does not accept newcomers. However, as Servalli (2018) finds, such interventions can lead to sudden and unanticipated changes in the participation of the community. In addition, a well-functioning community is an asset to a makerspace and the makers who practice commoning report a genuine interest in including less experienced users. The community connects makers, allows them to take ownership, supports a sustained activity, and ultimately, transforms a makerspace into a more coherent and meaningful place. From the spatial practice perspective, another tactic is to arrange activities directed at selected non-user groups. Dreessen and Schepers (2018), for instance, sought to recruit young people by making activities to fix and repurpose things and making football equipment, Roque (2016) recruited families in low-income neighborhoods to participate in “Eat, Meet, Make, Share” to enhance understanding and support dialogue around computing, and Kuznetsov et al. (Kuznetsov et al., 2011) invited ‘at-risk’ girls to participate in a five-week program using creative materials, including the Arduino LilyPad. These activities contribute to attracting new groups to the makerspace, strengthening knowledge about computing, and spreading awareness of the enabling options in makerspace. However, attracting and sustaining interest can be a troublesome affair (Kuznetsov et al., 2011), and recruiting non-users is, therefore, an important but costly practice that requires defining underrepresented groups, attracting them, arranging activities that overlap with interests of the group, and supporting the transition from a directed practice to a self-directed one. Finally, from the symbolic perspective, the decoration of the space, the tools available, and the online presence reflect what is appropriate in the particular makerspace (Menendez-Blanco and Bjørn, 2019). Lewis (2015) analyzes such representations from the perspective of women, suggesting that showcasing women’s projects, ensuring the representation of women in volunteering communities, and inviting women in as speakers reframe makerspaces towards arts and crafts instead of technology, arrange meet-and-greet sessions, demonstrate how tools can be used purposefully and creatively, and ensure the makerspace also spreads in other ways than by word-of-mouth. Underrepresented users might differ for individual makerspaces and the chances of failing to include them are high. Nonetheless, designing spaces that symbolically welcome diversity, allocating time and effort to define, attract, recruit, integrate diverse users, and caretake for and encourage an inclusive community are forefront if a makerspace seeks to take equity and inclusion seriously.

5.3. Limitations

In this study, there are three limitations worth considering. The data material is based on informal activities in library makerspaces in Denmark. Here the makerspace is available for the public and free of charge with the exception of prices of materials. Because all makerspaces are appropriated for their local conditions, the practices of crafting, connecting, and commoning should not be generalized as a comprehensive list covering all practices taking place in makerspaces, hackerspaces or FabLabs. Second, this study builds on interviews with makers. Interviewing users is a useful method to understand the meaning of makers practices and how projects develop over time and across situations. However, interviews build on individuals’ self-reported experiences, and therefore, might leave out details. This issue is mitigated by applying a project break-down activity in the interview procedure. Future studies could add more detail to the understanding of making in everyday life by applying ethnographic or autoethnographic methods. Third, the social, cultural, and economic impacts of the covid-19 pandemic are unforeseeable in terms of co-located practices taking place in makerspaces and public institutions. Therefore, this is a particularly interesting topic to follow.

6. Concluding remarks

This paper examines the unfolding of thirteen maker projects in everyday life. In supplement to prior research covering discourses, activities, and spatial configurations of making, this study contributes by addressing the interconnections between tools in library makerspaces to other places and situations in everyday life. Three practices that add quality to makers’ lives in different ways are analyzed and detailedly described. Crafting is an individual, recreational, skillful, and immersive practice; connecting is a creative, object-oriented, and interventionist practice; and commoning is social and communal practice. Also, the practices will include different expectations for a makerspace that can have practical implications on the design of spaces and prioritization of activities:

- Connectors expect easily accessible, efficient, and well-documented tools and services.
- Crafters expect to access specialized tools and detailed and technical information that can inform their already specialized projects.
- Commoners expect to meet others with a shared interest in technology and that the makerspace cares for the community and allows them ownership.

Also, because makerspaces seek to include inexperienced users in technology construction and libraries are institutions dedicated to
representing the diversity of their communities, barriers of inclusion, and strategies to overcome the barriers are discussed. It is argued that although a community might be homogenous, it is a resource to the makerspace that adds to the complexity of the inclusion challenge. As the inequalities in makerspaces are evident, it is relevant for future research in HCI to both address what can attract diverse users and relevant to identify boundaries, overlaps, gaps, synergies, and competition.

Credit authorship contribution statement

Aimi Mar Einarsson is the sole contributor of this work.

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